

Diet, Exercise, Mindfulness, and Relaxation: Stress Management and Stress Reduction

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### Abstract

Recognizing the growing problem of chronic stress in the United States, this paper explores the utility of diet, exercise, and mindfulness-based stress reduction to stress management and protection against periods of stress. A review of research relating diet and stress implicates poor nutrition and excess consumption of fat as increasing stress reactivity while a Mediterranean diet and supplementation with anti-oxidant vitamins, minerals and Omega-3 provide stress protection. The literature exploring the impact of exercise on stress affirms the positive role of vigorous or aerobic exercise in improving response to stress, protecting against the adverse health effects of stress, and reducing stress experienced by individuals dealing with chronic disease. Finally, studies evaluating the effectiveness of mindfulness-based stress reduction identify the practice as successful in lowering perceived stress, improving regulation of stress hormones, reducing hostile and impulsive behavior in young people, and leaving a positive state of mindfulness with low emotionality, contentment, and new life perspective.

*Key words:* stress, stress management, diet, exercise, mindfulness

### Diet, Exercise, Mindfulness, and Relaxation: Stress Management and Stress Reduction

In August of 2010 the American Psychological Association conducted a study of stress in the United States (APA, 2010) and concluded that the US population as a whole is over-stressed. Exasperated by several years of economic downturn, those in the US are finding it difficult to focus on health given the needs of work and the needs of family. Thus, coping with stress is having a deleterious effect on their physical and emotional health (APA, 2010). For example, the report notes that too much stress over an extended time can impair an individual's ability to engage in normal living by increasing fatigue, disrupting concentration, and heightening negative mood (APA, et al).

Families are also adversely impacted by stress. According to the APA, a sizable percentage of parents (32%) are suffering from extreme levels of stress which they recognize as potentially detrimental to their health and disruptive to the family and children. They are correct in this assessment as research has shown that perceived stress is associated with increased severity of premenstrual syndrome (Gollenberg, Hediger, Mumford, Whitcomb, Hovey, Wactawski-Wende, & Schisterman, 2010) and the susceptibility of children to disease later in life (Miller, Chen, & Parker, J. 2011).

### **Stress, Workplace, and Ethnicity**

There are other factors besides those related to the economy that contribute to stress, such as workplace and ethnic/racial factors. With respect to workplace stress, Chandola, Heraclides, and Kumari (2009) reviewed studies investigating plasma catecholamines, variability of heart rate, and cortisol levels after walking and concluded that employment stress is associated with higher levels of physiological stress markers consistent with greater activation of the sympathetic adrenal-medulla (SAM) and hypothalamic-pituitary-adrenocortical (HPA) axes. Examination of

stress associated with race/ethnicity has shown that Hispanic and African-American young people do in fact possess a flatter cortisol signature relative to Caucasians, and this flatter cortisol is a marker of higher risk of future ill health (DeSantis, Adam, Doane, Mineka, Zinbarg, & Craske, 2007). Interestingly, DeSantis, et al. (2007) found stress in Hispanic and African-American youth associated with patterns of negative emotion as opposed to socioeconomic status or environment.

### **Stress, Illness, and Disease**

It is well understood that stress and perceived stress in adults contribute to a wide range of disorders including hypertension and elevated plasma cortisol (Esler, Eikelis, Schlaich, Lambert, Alvarenga, Dawood, et al., 2008), cardiac and cardiovascular disease (Stanley & Burrows, 2008; Sarkar & Mukhopadhyay, 2008), inflammatory bowel syndrome (Jordan, 2010), Type II diabetes (Heraclides, Chandola, Witte, & Brunner, 2009), and reduced quality of life among those suffering with cancer (Hansen & Sawatzky, 2008; Kreitler, Peleg, & Ehrenfeld, 2007; van de Wiel, Geerts, & Hoekstra-Weebers, 2008).

### **Reducing Stress and Stress Management Approaches**

Given the adverse consequences of stress or perceived stress on both health and quality of life, the importance of both managing and reducing the effects of stress is self-evident. Fortunately, stress management has proven successful in reducing stress. For example, Storch, Gaab, Küttel, Stüssi, and Fend (2007) evaluated the long-term effectiveness of training in stress management on cortisol and the appraisal of stress and found reductions in salivary cortisol levels as well as reduced levels of appraised stress. Phillips, Antoni, Lechner, Llabre, Avisar, Gluck, et al. (2008) showed reduction in stress and lower cortisol levels in female cancer patients after completing a ten week stress management intervention focusing on cognitive-behavioral

factors. Finally, Daubenmier, Weidner, Sumner, Mendell, Merritt-Worden, Studley, and Ornish (2007) examined the triple effect of lowering the consumption of fat, increasing exercise, and providing stress management over a three month period on the risk of coronary heart disease and other psychosocial issues. Daubenmier, et al. (2007) found that both reductions in fat intake and exercise interacted to lower weight, lower cholesterol, and bring down levels of perceived stress. Also, reductions associated with stress management were associated with reduction in other physiological markers (e.g., triglycerides, A1c) and psychosocial markers (e.g., hostile behavior). Thus, stress management is an important tool in reducing stress and in altering the physiological effects of stress.

### **Stress Management Approaches**

This paper will follow the approach of Daubenmier, et al. (2007) and take an extended look at three stress management interventions: diet, exercise, and mindfulness, and their role in stress reduction. The discussion will focus first on the relationship between diet and stress.

#### **Diet and Stress**

**High Fat Diet and Stress Response.** Noting that improper poor diet and elevated stress act to disturb the balance of energy in the body and contribute to ill health and disease, Kitraki, Soulis, and Gerozissis (2004) described an animal study using Wister rats investigating the effects of a diet high in polyunsaturated fat (e.g., corn oil) and decreased consumption of carbohydrates and reduced intake of protein over seven days on both energy consumption and a subsequent stress reaction to a short stressor (e.g., swimming). Comparing levels of stress hormones in the high fat/low protein/low carbohydrate diet rats and normally fed rats, Kitraki, et al. (2004) found that the levels of corticosterone in both sets of rats were not different during the stressor. Additionally, corticosterone concentrations appeared to not be effected by the different

diets. However, further analysis of blood stains showed elevated levels of glucocorticoid receptors within the hypothalamic area of the rats fed normally while lower glucocorticoid receptors levels were found in the high fat/low protein/low carbohydrate diet fed rats. According to Kitraki, et al., the results highlight how quickly an improper diet with high fat intake and lack of other nutrients can adversely impact the balance of stress hormones as evidenced by lower glucocorticoids receptors in the hypothalamus known to mediate the effects of cortisol (Manary, Muglia, Vogt, & Yarasheski, 2006).

**Omega-3 and Perceived Stress.** Bradbury, Myers, and Oliver (2004) sought to determine if perceived levels of stress can be lowered through consumption of the omega-3 three fatty acid docosahexaenoic acid (DHA). For the study, participants employed at a university scoring high on a scale of perceived stress were randomly assigned to either a group taking fish oil supplements containing DHA or a group (e.g., placebo group) taking supplements of olive oil over a six-week period. For the analysis both the fish oil group and the olive oil placebo group were contrasted with each other as well as against a larger control population of individuals making up a cross-sectional sample. Following the six-week trial, analysis showed that perceived stress levels were significantly lower among both the fish oil and olive oil placebo groups. When comparing perceived stress levels between the fish oil group and the larger population, the fish oil group had significantly lower perceived stress. Yet, further analysis showed that there were no significant differences in perceived stress level between the fish oil and olive oil placebo group, and no significant difference in perceived stress level between the olive oil placebo group and the cross sectional control group. Overall, only the fish oil group showed significant reductions in perceived stress relative to the control sample consistent with the conclusion that omega-3 acts to attenuate perceived stress.

**Omega-3 and Posttraumatic Stress Disorder Prevention.** According to Matsuoka (2011), preventing the development of posttraumatic stress disorder (PTSD) among individuals following an accident is critical as up to 23% of individuals experience PTSD within 12 months of an injury due to an accident. Also, several risk factors contribute to a greater incidence of PTSD following an accident including factors such as being female, already suffering from depression, being admitted to an ICU as a result of the accident, being prescribed benzodiazepine, seeing the accident as life-threatening, and so on (Matsuoka, et al.) As a symptom of PTSD is intrusive memories and re-experiencing the accident, Matsuoka focused on how traumatic memories are formed following an accident, and that recent research has shown that the formation of traumatic memories following an accident do not become permanent at the time of the accident but sometime later as the memories are consolidated. Thus, focusing on the neurogenesis that occurs in the hippocampus (Kempermann, 2002), and noting that memory consolidation must involve interaction between the areas of the brain involved with fear (e.g., amygdala) and short-term memories (e.g., hippocampus), Matsuoka attempted to stimulate hippocampus neurogenesis using Omega-3 to assess its impact on the development of PTSD. Using 15 individuals who had recently experienced an injury due to an accident, Matsuoka gave the individuals Omega-3 (e.g., DHA, eicosapentaenoic acid) for 12 weeks. Measuring the individuals with a validated scale for assessing PTSD symptoms at the close of the intervention, Matsuoka found PTSD symptoms in only 6.7% of the original 15 indicating a reduction in PTSD progression. Though Matsuoka's research is preliminary, the findings indicate that giving accident survivors omega-3 fatty acid following injury from an accident may decrease their risk for developing PTSD.

**Diet, Stress, and Inflammation.** Inflammation is a biomarker of stress. According to Hänsel, Hong, Cámara, and von Känel (2010) situations such as work-related stress, stress associated with living in poor socioeconomic conditions, stressful events suffered in childhood, and stress associated with caring for another all contribute to chronic stress and influences the function of the immune system. Further, Hänsel, et al. (2010) describe how chronic stress impacts the HPA axis as well as the autonomic nervous system (ANS) resulting in increased levels of inflammation. Galland (2010) describes how research exploring the impact of nutrition and patterns of food consumption have identified associations with immunologic indicators of inflammation (e.g., interleukin-6, tumor necrosis factor alpha, C-reactive protein). Of those studies evaluating the effects of diet on inflammatory response, results indicate that changes in diet have affected levels of fiber, the mix of fatty acids, levels of magnesium, and other nutrient compositions (Galland, 2010). Further, Galland associates healthier, anti-inflammatory influences with food consumption patterns that result in a greater monounsaturated fat to saturated fat ratio, a greater Omega-3 to Omega-6 ratio, and greater levels of vegetable, fruit, whole grain, and legume consumption.

Bakker, van Erk, Pellis, Wopereis, Rubingh, Cnubben, et al. (2010) conducted a rigorous experiment to see if dietary changes could reduce moderate levels of chronic inflammation in individuals identified as being overweight. Bakker, et al. (2010) gave a sample of men who were overweight but healthy a mix of nutrients known to deliver anti-inflammatory effects (e.g., vitamin C, omega-3, extracts derived from green tea and tomatoes) for five weeks. Measures were taken of blood plasma, fat tissue, metabolic enzymes, and so on. At the end of the five weeks there were no changes in measures of inflammation (e.g., C-reactive protein). Yet, there were a wide range of very small alterations indicating some attenuation of inflammation in fatty



tissues as indicated by improved performance of endothelial tissue and oxidation of fatty acids in the liver. The outcomes indicate that adopting a diet high in anti-inflammatory and antioxidant properties can have beneficial impacts on inflammation and oxidative stress.

**Vitamins and Stress.** Supplementation with vitamins can reduce stress and improve overall mood. The benefit of vitamin supplementation in reducing stress and improving mood and mental performance was demonstrated by Kennedy, Veasey, Watson, Dodd, Jones, Maggini, and Haskell (2010) in a sample of working males between the ages of 30 and 55. These males were required to visit a laboratory at the beginning and end of the experimental trial where they filled out a questionnaire measuring their mood state, a questionnaire measuring their perceived stress, and a questionnaire assessing their overall health. A measurement of cognitive functioning, mood change, and fatigue were also assessed during one hour battery of cognitive tests. The men were then randomly assigned to an experimental or control group. For over 30 days the men in the experimental group received direct supplements of vitamins and minerals. During the last day of the trial all men were asked to walk on a treadmill as they were engaged in a test of cognitive function. Analysis showed that the men who received supplements of vitamins and minerals exhibited improved cognitive performance, lower rated stress, improved mental functioning, and heartiness.

A study conducted by Mishra, McNaughton, O'Connell, Prynne, & Kuh (2009) further demonstrates how insufficient amounts of vitamins, specifically B vitamins, can contribute to distressed mood. Mishra, et al. (2009) assessed the impact of vitamin levels (e.g., vitamins B6, B12, niacin, folate, etc.) taken as a child and taken as an adult on women's psychological state during adulthood. Using a standardized questionnaire to assess levels of psychological distress and a memory recall session to assess patterns of food consumption and vitamin intake during

childhood, Mishra, et al. collected food intake information from a sample of women going as far back as age 4 and later ages leading to adulthood. Upon analysis, Mishra, et al. found that only deficient levels of vitamin B12 taken at their current adult age had an association with higher reporting of psychological distress.

### **Exercise and Stress**

**Exercise, Stress, and Health.** Seeking to investigate if exercises' benefit to health is due to its moderation of stress response, Gerber and Pühse (2009) conducted an in-depth review of research studies as far back as 1982 which evaluated the potential role of exercise on stress. Of the studies identified only half identified partial relationships between exercise, stress, and health. For example, Gerber, et al. (2009) noted that individuals in the studies who engaged in regular vigorous exercise showed minimal adverse health effects during periods of stress. Applying an analysis methodology in an attempt to tease out causality, Gerber, et al. identified consistent results with respect to the role of exercise in reducing the effects of stress even though various studies employed different research methods and analysis procedures. Gerber, et al. concluded that exercise is a valuable asset to those working to improve public health. Future research questions posed by Gerber, et al. include the need to understand the level of exercise required to achieve stress moderation, and the kinds of exercise which deliver this affect most efficiently.

**Exercise and Breast Cancer.** Hughes, Leung, and Naus (2008) observed that few women who are Hispanic show regular engagement in regular exercise, and by coincidence cancer rates and higher instances of mortality from cancer are found among them relative to other ethnic groups. Stress among Hispanics increases the risk of several adverse health conditions such as impaired immune function, impaired healing of injuries, and psychosocial

problems (Hughes, et al.). Using a research methodology that allowed for analyses by group and within the individual, Hughes, et al. conducted a study using Hispanic women who had survived cancer and not received treatment for six months or more. Of the measures to assess outcomes, Hughes, et al. assessed physical attributes such as cardiovascular functioning, percentage of body fat, and flexibility. Hughes, et al. also included a measure of self-reported health status (e.g., SF 36) that included subscales measuring physical status and mental status, and a standardized measure of perceived stress. Finally, the authors used measures of nocturnal salivary cortisol to measure the stress response. All participants were subjected to a five-week tailored exercise intervention involving 60 min. of aerobic and strength training exercise. At the group level, Hughes, et al. found that all measures of physical fitness showed improvement and levels of salivary cortisol decreased according to levels of participation. Analysis of exercise impacts at the individual level revealed reduction of body fat, improve physical fitness, and lower levels of stress but some raising of quality of life.

**Exercise, Stress, and Telomere Chromosome Length.** According to Puterman, Lin, Blackburn, O'Donovan, Adler and Epel (2010) the adverse effects on health that follow chronic stress may be related to advanced aging processes in the cells evidenced by reduced lengths of chromosome telomeres (e.g., endings). Noting that chromosome telomeres with reduced length are not found in all individuals suffering from stress, Puterman, et al. (2010) conducted a study to see if exercise can moderate stress and reduce the impact of stress on chromosome telomere length. Using a sample of 63 older but otherwise healthy females, Puterman, et al. drew blood from the participants after they had engage in fasting to assess chromosome telomere lengths. Additionally, the participants completed a standardized assessment of perceived stress, and were asked to report the number of minutes they engaged in a vigorous exercise over the course of

three days. Puterman, et al. used the exercise data to divide participants into an active group and a sedentary group, and assessed the association of chromosome telomere lengths with perceived stress levels and average number of minutes of vigorous exercise per day controlling for age, body mass index (BMI) and educational level. Consistent with other research, analysis conducted by Puterman, et al. showed that exercise has an attenuating affect on stress. Further, Puterman, et al. found that, among the participants in the sedentary group, every unit that perceived stress increased raised the odds of shorter chromosome telomeres by 15 times. In contrast, Puterman, et al. found no such relationship among the participants in the exercise group. Puterman, et al. concluded that those who engage in regular physical exercise appear to be protected from the effects of stress on chromosome telomere length.

**Mental Stress, Physical Stress, and Stress Response.** An interesting dynamic investigated by Webb, Weldy, Fabianke-Kadue, Orndorff, Kamimori, and Acevedo (2008) is the responsiveness of the heart and respiratory system, and hormones associated with the stress, under conditions of physical stress in the context of mental stress. Participants in the study were assessed for their respiratory capacity and then involved in two experimental treatments. According to Web, et al. (2008), in the first condition participants were asked to ride a stationary bike for just over a half hour at 60% of the respiratory capacity while simultaneously engaging in a computer-based mental exercise representing a condition where both physical and mental faculties were being exerted. In the second control treatment, participants performed the same physical activity without the exertion of mental faculties. Analysis by Web, et al. over the duration of the physical activity found increases in heart and respiration activity, and aeration indicative of both physical stress and mental stress. The assessment of stress hormones (e.g., norepinephrine, cortisol) found significantly elevated levels associated with the physical

activity/mental activity treatment in contrast to the physical activity treatment alone. Web, et al. interpreted this as evidence of that involvement with a stress provoking mental activity while engaging in physical activity can worsen the stress response resulting in greater secretion of stress hormones known to adversely impact immune function, metabolism, and heart health.

**Inflammatory Bowel Disease.** According to Jordan (2010), perceived stress has been shown to exacerbate intestinal inflammation in individuals suffering from inflammatory bowel disease (IBD). According to Packer, Hoffman-Goetz, and Ward (2010), several studies investigating the influence of exercise/physical activity on IBD have identified positive outcomes. For example, in a review of seven published articles, Packer, et al. identified four that reported improvements in IBD sufferer's quality of life, and two that identified reductions in IBD symptoms. These studies certainly support the use of exercise/physical activity as an additional therapeutic approach to improve quality of life for those suffering from IBD.

**Physical Activity and Crohn's Disease.** While Crumbock, Loeb, and Fick (2009) note that physical activity is an effective method of managing stress in the context of many diseases, their research was designed to study how both stress and physical activity influence Crohn's disease. Crumbock, et al., (2009) recruited a small sample of individuals with Crohn's disease and had them complete assessments of their level of physical activity, their perceived level of stress, their current experience with Crohn's disease, and their perceived quality of life. Evaluating the associations of the various assessments, Crumbock, et al. only identified associations between physical activity and quality of life, and stress and quality of life. The association was positive between physical activity and quality of life, but negative between stress and quality of life. Thus, physical activity improved quality of life among the Crohn's disease sample while stress reduced it.

## **Diet and Exercise**

Kelley (2009), recognizing the adverse effects of chronic stress on the body signified by disruption in the balance of stress hormones (e.g., catecholamines, cortisol) and immune function, discussed the role of both exercise and diet in reducing stress. With respect to forms of exercise which have beneficial effects on stress, Kelly describes a half hour of aerobic exercise, strength training, or stretching (i.e., yoga) as beneficial to stress reduction. Also, Kelly stresses the benefits of engaging in exercise in areas outside where there is plenty of fresh air and natural sunlight. According to Kelly, brain function is helped by exercise due to its affect on improved blood flow, oxygen transport, and neurogenesis involved the maintenance of neural plasticity in the maintenance of many neurochemicals (e.g., dopamine, serotonin). Additionally, Kelly describes how exercise may also serve to weaken those neural mechanisms involve the stress response resulting in lower sympathetic nervous system activity in response to perceived stress. With respect to diet and stress, Kelly focuses on the stress reducing benefits of the Mediterranean diet mainly associated with reducing intake of foods containing saturated fats, increasing consumption of food with high concentrations of monounsaturated fats, and increasing intake of foods high in fiber. Kelly describes the Mediterranean diet as consisting of high consumption of “fruits, vegetables, bread and other cereals, potatoes, beans, nuts and seeds” (p 38); olive oil; moderate consumption of fish, poultry, but lower consumption of red meats (e.g., steak); weekly consumption of up to four eggs, and occasional wine. Kelly also recommends the use of supplements including multivitamin supplements, the intake of B complex vitamins, particularly vitamin B12; supplemental intake of calcium, magnesium, sodium, manganese, omega-3 fatty acids, vitamins E and C, and finally supplementation with zinc, selenium, and copper. Kelly notes that following recommended levels of physical activity and patterns of nutrition consistent

with the Mediterranean diet along with recommended supplements can provide a preventive effect against the adverse results of chronic stress.

Khubchandani, Nagy, Watkins, Nagy, and Balls (2009) provide an interesting example of how high and low levels of stress, specifically work related stress, and perceived health status are associated with patterns of diet and exercise. Khubchandani, et al. (2009) conducted a study to find employees with elevated perceived stress and a coping style dominated by emotion focused coping and employees with lower perceived stress and a coping style characteristic of problem focused coping and compare the two groups across various health measures (e.g., BMI, self-reported health status, patterns of diet and exercise, perceived barriers to practicing a good diet and healthy levels of exercise). Analysis showed that employees who rated themselves high in work related stress included a higher proportion of those overweight, more employees who rated their health either fair or poor, more employees who reported low levels of exercise, and more employees who reported unbalanced diet and greater consumption of junk food relative to those employees with low levels of perceived work-related stress. While only associational, these findings are in agreement with Kelley (2009): Employees who reported better eating patterns and regular engagement of exercise reported lower levels of perceived work-related stress.

**Diet, Exercise, and Cardiovascular Disease.** The objective of the research conducted by Ignarro, Balestrieri, and Napoli (2007) targeted the establishment of evidence-based support for the benefits of exercise and nutritional diet to cardiovascular disease, as well as to adverse conditions deriving from atherosclerosis in the context of impairment in the functioning of endothelial cells due to oxidative stress. Ignarro, et al. (2007) discuss findings indicating that deficiencies in the availability of nitric oxide as a result of oxidative stress appears to be a typical impairment of molecular function encompassing atherosclerosis related cell damage. Further,

according to Ignarro, et al., it only takes expending approximately 1000 kcal per week, about the same as energy used to walk for one hour or five days, to obtain real positive impacts on health. Also, similar positive benefits can be obtained from engaging in short periods of physical activity (i.e., as short as 10 min.) throughout the week. With respect to diet and cardiovascular disease, Ignarro, et al. describe the findings of recent studies indicating an association between elevated instances of cardiovascular impairment, unstable angina, and stroke due to plaque with insufficient consumption of fruits and vegetables. Further, Ignarro, et al. indicate that a wide range of nutrients found in fruits and vegetables may work independently or together to deliver lower risk for cardiovascular disease, and also report on, consistent with previously discussed research, the positive benefits of antioxidants, fibers, omega-3, vitamins, minerals, and specialized herbs in the reduction, prevention, and management of cardiovascular disease.

**Diet, Exercise and Coronary Heart Risk.** While independent lifestyle interventions such as reducing unhealthy fat intake, engaging in more physical activity, or practicing stress management exercises have been shown to lower the risk of coronary heart disease, (Daubenmier, Weidner, Sumner, Mendell, Merritt-Worden, Studley, & Ornish, 2007) conducted research to examine the effectiveness of multi-component effectiveness of lifestyle interventions in preventing coronary heart disease. Focusing on three interventions - diet, exercise, and different forms of stress management, Daubenmier, et al. (2007) sought to examine the way the various interventions interacted and contributed to reducing coronary heart disease risk by way of changes in blood pressure, total cholesterol, and exercise capacity as well as affects on other issues such as reported levels of depression, hostility, and perceived stress. A large sample of both males and females were recruited to the program and required to participate in learning sessions about cooking, an hour of exercise, and an hour of stress management. Participants were



also required to eat a meal following dietary guidelines, and take part in all interventions two times per week for three weeks. Measurements were taken before and at the completion of the intervention. A direct comparison of baseline measures with measures collected at the end of the intervention identified a wide range of reductions including reduced percentage of dietary fat, and reductions in a range of coronary risk factors including weight, diastolic blood pressure, total cholesterol, triglycerides, and hemoglobin A1 C. Additionally, significant increases in hours of stress management coincided with reductions in depressive symptoms, hostility, and perceived stress. With respect to the multi-component contribution of all interventions on reduction of coronary heart risk, depressive symptoms, hostility, and perceived stress, Daubenmier, et al. found that stress management, dietary intervention focused on reduced fat intake, and exercise all contributed significant main effects additively contributing to reducing coronary heart disease risk factors. Examining psychological variables, stress management was the only intervention successful in reducing levels of hostility while both exercise and reduced fat intake contributed to the reduction of perceived stress.

### **Mindfulness and Mindfulness-based Stress Reduction**

Mindfulness is characterized as “a state of active, open attention on the present” (Mindfulness, 2011). In a state of mindfulness where attention is only focused on the Now of the moment an individual is able to observe thoughts objectively, without emotional engagement, and without judging these thoughts as either good or bad, or positive and negative. Mindfulness is also identified with five “skills” assessed by the Five Facet Mindfulness Questionnaire consisting of “observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience” (Baer, Smith, Lykins, Button, Krietemeyer, Sauer, et al., 2008 [Abstract]). Recent examination of the effect of mindfulness from a neuroscience

perspective has found that extended periods of mindfulness practice appears to affect the neural circuitry between the prefrontal cortex and the amygdala resulting in negatively correlated patterns of response to affective content (Creswell, Way, Eisenberger, & Lieberman, 2007). This negative correlation of the neural response link between the prefrontal cortex and the amygdala following mindfulness practice suggests an important impact on stress given that the amygdala is a key component of those neural centers involved with the stress response (Dedovic, Duchesne, Andrews, Engert, & Pruessner, 2009) and also influences concentrations of cortisol in the blood (van Stegeren, Wolf, Everaerd, Scheltens, Barkhof, & Rombouts, 2007).

**Mindfulness, Stress Reduction, Psychological Well-Being, and Cancer.** Bränström, Kvillemo, Brandberg, and Moskowitz (2010) conducted research to examine how training in mindfulness-based stress reduction might be useful in lowering levels of stress and improving areas of psychological performance among a sample of 70 males and females with an average age of 52 years and a prior diagnosis of cancer. In addition, Bränström, et al. (2010) sought to examine if the development of mindfulness skills played a role in mediating the outcomes obtained. For the experiment, participants were randomly assigned to either mindfulness training or a control group. Those assigned to mindfulness training received eight weeks of training. In the experimental group and the control group were compared across measures of perceived stress, avoidance of symptoms consistent with posttraumatic stress, and positive mental state. According to Bränström, et al., the participants who received the mindfulness training reported elevated levels of the mindfulness skills as assessed by the Five Facet Mindfulness Questionnaire in contrast to the controls. Further analysis also demonstrated that elevated mindfulness skills played a mediating role in the effectiveness of the mindfulness-based intervention to lower perceived stress, reduce symptoms of avoidance to posttraumatic stress, but improve positive

mental state. Based on the results, Bränström, et al., concluded that the positive benefits of mindfulness-based stress reduction training on measures of psychological function and stress are due to elevated levels of a mindfulness dispositional state.

**Mindfulness-based Stress Reduction, Cancer, and Cortisol.** Matousek, Pruessner, and Dobkin, (2011) conducted a study to examine the impact of mindfulness-based stress reduction on cortisol levels found during the awakening cortisol response (ACR) (Hanson & Chen, 2008) among a sample of 33 breast cancer patients. For the study, Matousek, et al. (2007) asked the breast cancer patients to report on stress levels, depressive symptoms, and health related symptoms both before and after the mindfulness-based stress reduction intervention. ACR was also assessed twice in the same way. According to Matousek, et al., three days following the mindfulness-based stress reduction practice ACR levels were found to have increased. In addition, Matousek, et al found positive changes in reported stress, depression, and health symptoms. Interestingly, Matousek, et al also found the reduction in stress, depression, and health systems were negatively correlated improvements in the ACR. The authors concluded that ACR is a good marker of stress among breast cancer patients which response to mindfulness-based stress reduction.

**Mindfulness-based stress reduction and School Teacher Stress.** Recognizing that individuals making a living as teachers are subject to ill effects on health and psychological issues due to stress, Gold, Smith, Hopper, Herne, Tansey, and Hullan (2010) conducted research to test the effectiveness of mindfulness-based stress reduction in reducing stress among individuals teaching elementary school. For the intervention, teachers participated in a training program where mindfulness-based stress reduction techniques were learned and practiced. To evaluate the effectiveness of the mindfulness-based practice teachers completed assessments of

self-reported anxiety, depressive symptoms, and perceived stress both before and after the mindfulness-based practice. As found with Matousek, et al, the comparison of pre-intervention and post-intervention measures identified significant reductions in reported anxiety, stress less, and depressive symptoms. Thus, Gold, et al. demonstrated that mindfulness-based stress reduction is an effective and affordable method for reducing stress levels in teachers and potentially reducing the rates of teachers departing from the field.

**Mindfulness-based Stress Reduction and Urban Youth.** The studies reviewed above demonstrate the benefits of mindfulness-based training on adults. In an attempt to expand the reach of mindfulness-based stress reduction, Sibinga, Kerrigan, Stewart, Johnson, Magyari, and Ellen (2011) examined the impact of mindfulness-based stress reduction training on adolescents and young adults at risk or diagnosed with HIV living in an urban environment. The research was conducted to assess how well mindfulness-based stress reduction is accepted among this population as well as the impact of mindfulness training on psychological issues such as hostility, adverse physical issues, and emotional issues. For the study, Sibinga, et al. (2011) recruited participants ranging in age from 13 years old to 21 years old from a nearby urban clinic. Participants completed psychological assessments prior to mindfulness-based stress reduction training as well as an assessment of quality of life. Participants were asked to take part in four different mindfulness-based training groups consisting of one weekly session per week over nine weeks. At the completion of all mindfulness-based training sessions Sibinga, et al. (2011) carried out an analysis which included the examination of participant attendance as a gauge of acceptability, examination of the psychological (e.g., hostility, emotional) issues and quality of life; and also conducted personal interviews with available participants. The analyses conducted by Sibinga, et al. included pre-and post-comparisons of the psychological measures

and an in-depth review of the information obtained to the personal interviews. An analysis of mindfulness-based stress reduction training participation showed that of participants beginning the training nearly 80% showed consistent attendance. This final set of participants included only African-Americans who were mainly of female. According to Sibinga, et al, post-intervention analysis of the psychological measures revealed significant decreases in the measures of a hostility, discomfort, and emotional issues. Additionally, analysis of qualitative information collected from the personal interviews by Sibinga, et al, revealed that participants perceived benefits following the mindfulness-based stress reduction training including improved relationships with friends, improve performance in school, improvements in health, and lower levels of stress. Sibinga, et al. interpreted the results of the research is indicating that training urban youths in mindfulness-based stress reduction is feasible and has been shown to yield positive results with respect to psychosocial issues such as hostility, relationships, school performance, and improvements in health.

An additional study investigating the utility of mindfulness-based stress reduction on urban youths was conducted by Kerrigan, Johnson, Stewart, Magyari, Hutton, Ellen, and Sibinga (2011) who executed the same qualitative interview methodology carried out by Sibinga, et al. (2011) on a subset of same participants researched by Sibinga, et al. For this study, Kerrigan, et al. (2011) utilized personal interviews to examine how the urban youth and young adults responded to the experience of mindfulness-based stress reduction participation. Qualitative analysis showed that participants experience the benefits from the mindfulness-based training as well as improved levels of personal self-awareness. Differences in perceptual and self-reorienting changes were also identified as illustrated by reduced responsiveness to stress and significant changes in the way participants approached life and experienced greater contentment.

Thus, Kerrigan, et al. provided demonstrated that the effects of mindfulness-based stress reduction extend beyond stress reduction.

**Mindfulness and Symptom Reduction.** Affirming the growing recognition of the effectiveness of mindfulness-based stress reduction in improving health and psychological issues, Dobkin and Zhao (2011) sought investigate the mechanisms by which such outcomes are obtained by exploring the association between growing levels of mindfulness and positive patient results. In addition, Dobkin, et al. attempted to uncover the aspects of mindfulness-based training responsible for post-intervention results. A sample of 83 participants diagnosed with chronic illness was recruited for the research. All participants provided pre-and posttest assessments of mindful attention, depression, medical symptoms, perceived stress, sense of coherence, and engagement in various components of mindfulness (e.g., frequency of mindfulness engagement, time spent meditating, awareness of breath, benefit of breath awareness, and importance of the mindfulness-based stress reduction training). Comparison of measures pre-and post-mindfulness training showed reduction in depression, perceived stress, and reported medical conditions as measures of mindfulness and sense of coherence increased, thus demonstrating an inverse correlation between increasing levels of mindfulness and decreasing levels stress, depression, and medical problems. Unfortunately, the data did not indicate the components of mindfulness responsible for the observed outcomes sought by the researchers.

**Mindfulness-based Stress Reduction and Glycemic Control.** Noting that significant levels of distress is experienced by diabetics due to glycemic control problems, Rosenzweig, Reibel, Greeson, Edman, Jasser, McMearty, and Goldstein (2007) sought to investigate the effects of mindfulness-based stress reduction on glycemic control, arterial blood pressure, weight, depressive symptoms, anxiety levels, degree of somatization, and reductions in overall

severity among a sample of diabetic patients. One month following the end of mindfulness-based training, Rosenzweig, et al. found no changes in weight but observed reductions in all the other measures of interest including hemoglobin A1c, average arterial blood pressure, and all the psychological measures (e.g., distress, depression, anxiety). Thus, Rosenzweig, et al. provided evidence that mindfulness-based stress reduction is a useful intervention to help diabetics gain better control of blood glucose levels.

### **Relaxation and Stress Reduction**

Having provided an overview of the effectiveness of mindfulness-based stress reduction in treating stress and improving psychological and physical function, this paper will close with a brief look at relaxation therapy and its role in stress reduction.

Ali and Hasan (2010) sought to demonstrate the relevance of relaxation therapy in treating anxiety by presenting a case study of a female plagued by both pain and fatigue which impaired her occupational performance and disrupted her everyday life. Psycho diagnosis identified her as suffering from clinical anxiety. Having failed to receive benefit from treatments she had previously attempted, she was treated with relaxation therapy within a clinical psychological environment which also included a breathing exercise and visualization of perfect vacation conditions and perfect relaxation. Measures of anxiety and depressive symptoms were obtained before and after the relaxation/visualization. After experiencing the various elements of relaxation therapy she was able to apply the techniques by herself. According to Ali, et al. significant reductions are obtained in reported anxiety levels and depressive symptoms. Additional changes reported by patient included less tension in the muscles, improved sleep, fewer instances of disturbed sleep, and elimination of impairments to occupational and social performance.

Seeking to improve on the repertoire of interventions that can be applied to adolescent males with high levels of hostile action, Gaines and Barry (2008) conducted research to examine the efficacy of a relaxation intervention that involved deep breathing in improving levels of impulse control as measured by the use of foul language, decreasing instances of disruptive behavior in a juvenile management setting, and increasing levels of voluntary self-monitoring among adolescents with respect to user file language and aggressive behavior in an independent living situation. The research involves six adolescents who were individually tracked over the course of the study. All six adolescents were exposed to the relaxation/deep breathing intervention twice with a gap between the first and second exposure. The primary outcome measures were frequency of using foul language, frequency of inappropriate aggressive behavior, and a measure of self-monitoring. Upon analysis divergent results are obtained with only two of the six adolescents showing improved impulse control, improved behavior, and approve self-monitoring.

### **Conclusions**

Recognizing the growing problem of stress in society and its deleterious impact on health with respect to the stress hormone imbalance (e.g., cortisol) and inflammation, this paper has examined effectiveness of diet, exercise, and mindfulness-based stress reduction in reducing stress.

With respect to diet, improper nutritional balance, insufficient vitamin intake, and excess consumption of fat have been shown to exacerbate the stress response and create unhealthy balances of stress hormones in the brain and body. The dietary patterns shown to create positive protective effects against stress and inflammation are consistent with the Mediterranean diet consisting of increased levels of vegetables, fruit, whole-grain, nuts, seeds, beans, potatoes, eggs



and higher levels of fiber along with lower levels of steak and other red meats. Stress reduction is also aided by supplementation with vitamins and minerals including magnesium, calcium, manganese, B vitamins, and vitamin C and E. Additional stress protection can come through the intake of omega-3 fatty acids, particularly DHA from fish oil, and increasing the ratio of monounsaturated fats (e.g., omega-3) to saturated fats (e.g., Omega 6).

Regular vigorous or aerobic exercise is protective against stress as it has been shown that negligible undesirable health effects follow stressful situations among individuals who regularly engage in this type of exercise. Even regular short periods of exercise can deliver positive health benefits. Exercise has been shown to be an effective stress reduction approach among individuals with a variety of health conditions including cancer, inflammatory bowel syndrome, and Crohn's disease. Exercise also been shown to have positive health benefits beyond stress reduction including improve physical fitness, the maintenance of healthy levels of cortisol, reduction in body fat, and improved quality of life. Interestingly, regular vigorous exercise has also been shown to slow the aging process associated with stress at the genetic level!

The combination of diet and exercise has been shown to have similar effects on stress reduction in the general population and to deliver other positive health effects including lower weight and reductions in diastolic blood pressure, cholesterol, hemoglobin A1 C, symptoms of depression, hostile attitude, and perceived stress.

Finally, a review of the research exploring the practice of mindfulness-based stress reduction as a stress management approach has reported consistent patterns of reduced stress and improved cortisol regulation among cancer patients, reduced stress and lower rates of burnout among school teachers, and reductions in levels of hostility, impulse control, and emotional issues among urban youth. These effects have also proven consistent with studies in

neuroscience showing reduced levels of interactivity between awareness centers and emotional centers in the brain. Additionally, the resultant state of mindfulness following an extended period of mindfulness-based stress reduction practice has also been shown to change life perspective, decrease emotional reactivity, and increase levels of contentment.

### **Building Adoption**

The key ingredient to reducing and managing stress through diet, exercise, and mindfulness-based practice is doing them. Individuals must consistently engage in these practices for them to benefit health, well-being, and keep stress low. Unfortunately, the fact is that's only a minority of individuals adopt one or more of these stress reduction options. In the 2010 APA study of stress, the report included statistics on the importance and achievement of issues relevant to well-being as reported by parents in the chart, "Aspects of Well-Being" (p 9). The chart lists seven different issues identified by parents as relevant to well-being. The second issue listed is managing stress. And while 69% of participants classified stress management as important, only 32% reported achieving it. The bottom three issues identified as relevant to well-being include eating healthy, getting sufficient sleep, and being healthy and physically fit. Looking at the responses for eating healthy, 64% of participants identified the issue as important but only 30% reported achieving it. With respect to being healthy and physically fit (which requires regular exercise), 60% of participants identified the issue as important, and only 29% reported achieving it. Data such as this indicate that the challenge before diet, exercise, and mindfulness as stress management approaches is getting individuals to adopt them and sustain their practice through life. Understanding why some individuals adopt health-focused lifestyles that protect against stress and others do not is an area of research I would like to develop post-doctorally.

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